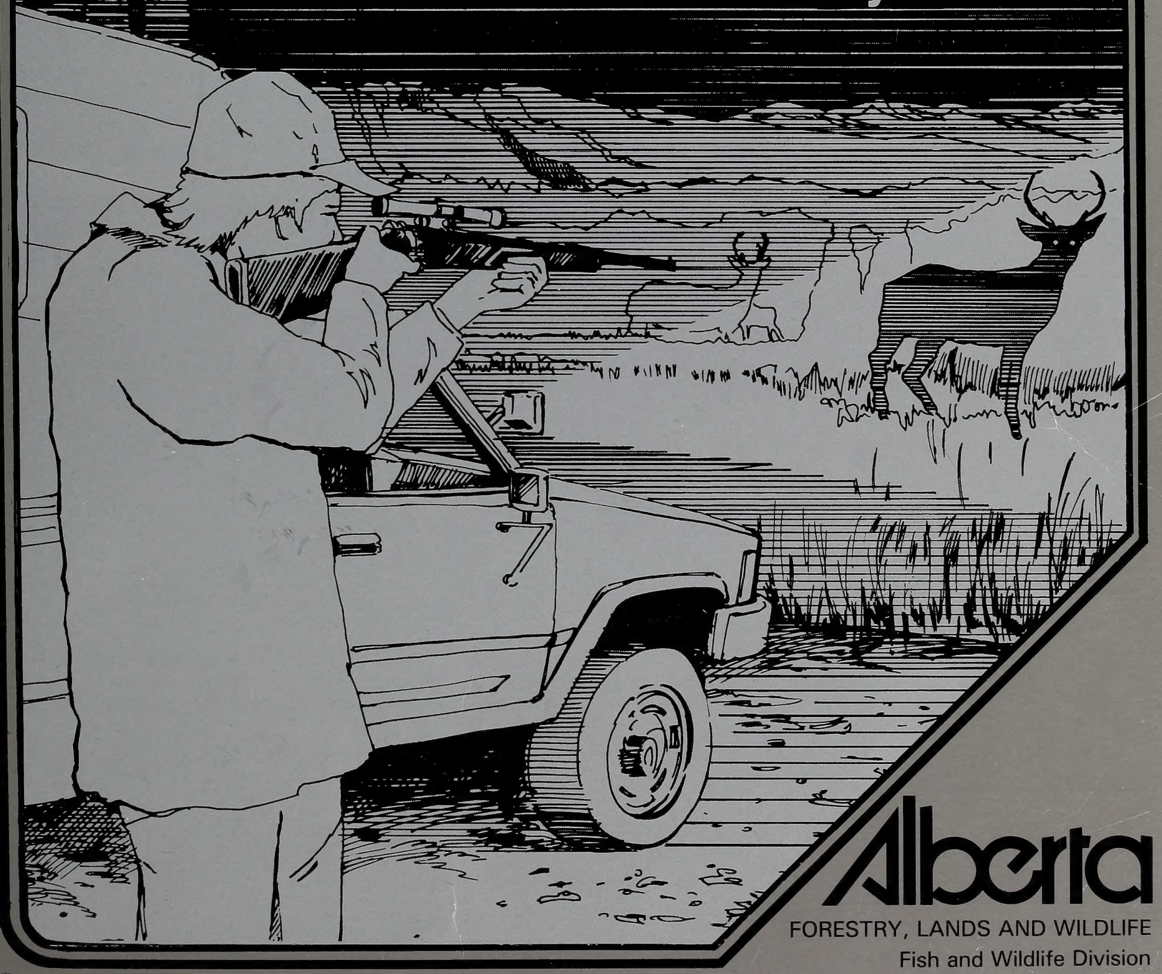
AL.2.1987-114

# ESTIMATES OF THE ILLEGAL HARVEST OF DEER IN ALBERTA: A Violation Simulation Study.



Alberta
FORESTRY, LANDS AND WILDLIFE
Fish and Wildlife Division

Resource Economics and Assessment
Occasional Paper Number 2

National Library of Canada
Bibliothèque nationale du Canada

CANADIANA
C 2
OCT 21 1987

# ESTIMATES OF THE ILLEGAL HARVEST OF DEER IN ALBERTA: A VIOLATION SIMULATION STUDY

by

Peter C. Boxall

and

Laverne C. Smith

Alberta
Forestry, Lands and Wildlife
Fish and Wildlife Division
Resource Economics and Assessment Section
Occasional Paper Number 2

1987
Edmonton

PUB No: T/146
ISBN: 0-86499-453-2
Occasional Paper Number 2

FOR ADDITIONAL COPIES OF THIS REPORT, CONTACT:

Information Centre
Alberta Energy
Alberta Forestry, Lands and Wildlife
Main Floor, Bramalea Building
9920 - 108 Street
Edmonton, Alberta, Canada
T5K2M4

Telephone: (403) 427-3590

# EXECUTIVE SUMMARY

This report describes the results of one of the most comprehensive violation simulation studies conducted in North America. The purpose of this study was to derive a measure of the illegal harvest of deer.

During 1985 an individual simulated 649 instances throughout Alberta of activity involving illegal hunting or harvest of deer. These simulations were used in a mark-recapture experiment to derive provincial estimates of illegal activity. This experiment, called a violation simulation study, attempts to relate known, or simulated violations ("marked sample"), to reports of these violations to the agency ("recaptures"). From this comparison a ratio of detected to known violations is determined. This ratio can be used in a mathematical method to arrive at an estimated total number of violations during a year.

In this study 649 simulations were compared to 483 actual reports to the division of illegal harvest activities during 1985. Only seven of the 649 simulations were reported. From this it is estimated that only about 1% of actual illegal harvest activities involving deer are reported to the division in a year.

By using specific simulations, actual reports, and recaptures that involved illegal harvest of deer, it is estimated that in 1985 17,012 ± 11,586 occurrences involving the death of at least one deer took place. The actual harvest estimate could be 25,716 ± 17,495 deer by using measures of the number of deer killed per occurrence. Estimated illegal deer harvest is about half the legal harvest of deer taken by licensed recreational hunters.

There were few public reports of illegal activity during the non-hunting season but reports increased dramatically in the fall, during the legal hunting

season. This occurred despite most simulations being conducted from January to August, and despite 139 of 649 simulations being directly observed by landowners or other members of the public. Possible reasons for the lack of reports of illegal activity are: 1) lack of awareness by the public about what constitutes a violation; ii) the probability of violators being friends or relatives; iii) sectors of the public having negative attitudes toward wildlife; iv) illegal harvest activities not being considered significant enough to report.

Further studies are required to investigate the public's attitude toward illegal harvest activities, and the division's role in public education and awareness of poaching.

# TABLE OF CONTENTS

Page

INTRODUCTION .................................................. 1

METHODS .................................................. 4

A. The Petersen Method .................................................. 4

B. Reports of Violations - The Animal Incident Reporting System.... 6

C. Simulations .................................................. 8

RESULTS .................................................. 14

A. Field Operations.................................................. 14

B. Reports of Illegal Hunting of Deer to the Division.............. 24

C. Estimates of Illegal Activity and Harvest........................ 27

DISCUSSION .................................................. 36

A. Major Findings.................................................. 36

  1. The 1% Reporting Rate of Violations........................ 36

  2. Estimates of the Number of Deer Killed Illegally............ 37

B. Illegal Harvest Compared to Legal Harvest by Sport Hunters...... 39

C. Questions and Recommendations for Further Research............. 42

LITERATURE CITED .................................................. 46

APPENDICES .................................................. 48

  1. The Petersen Method: Detailed Calculations.................. 48

  2. Summary of Actual Occurrences (AIRS) not Included in this Study.................................. 51

Digitized by the Internet Archive
in 2015

https://archive.org/details/estimatesofilleg00boxa

## LIST OF FIGURES

Figure Page

1. Geographical Distribution of Simulations by Time Period..... 18
2. Numbers of Reports of Occurrences of Illegal Activity and Simulations by Month.................................... 27
3. Estimates of Illegal Activity Involving Deer in Alberta During 1985.................................... 30
4. Estimates of the Illegal Harvest of Deer in Alberta During 1985.................................... 31
5. The Effect of Variation in the Number of Simulations Used in the Petersen Method on the Illegal Harvest Estimate ............................ 40

# LIST OF TABLES

Table Page

1. The Frequency of Occurrences of Illegal Hunting Involving Deer in Alberta from the AIR System............. 12

2. Frequencies of Types of Simulations and Activities Performed During Those Simulations........................ 15

3. Frequencies of Observations and Other Activities Recorded by the Agent During Simulations....... .......... 16

4. Frequencies of Simulations by Two-month Periods........... 19

5. Frequencies of Human Related Factors Present During Simulations........................................ 21

6. Summary of Simulations Reported to the Fish and Wildlife Division......................................... 23

7. Characteristics of Actual Occurrences of Illegal Deer Hunting Reported to the Fish and Wildlife Division During 1985....................................... 25

Table Page

8. The Distributions of Simulations and Actual Reported Illegal Activity by Administrative Region.................. 28

9. Estimates of the Illegal Harvest of Deer During 1985............................................ 34

10. Comparison of Estimates of Legal and Illegal Deer Harvest in Alberta During 1985......................... 41

# ACKNOWLEDGMENTS

This study stemmed from investigations conducted by the Special Investigations Unit of the Enforcement-Field Services Branch. It is through their efforts in imaginative undercover investigations that this study is possible. Their work should help wildlife management programs become more effective in Alberta.

Numerous individuals provided advice, guidance and constructive criticism during the preparation of this report. We thank Bob Adams, Bill Glasgow, Mike Melnyk, Jim Nichols, Ernie Psikla, Dennis Surrendi and Stan Webb for their assistance. Carol Powell and Bev Michaels helped us locate numerous occurrence reports and provided help with their interpretation.

# INTRODUCTION

Essential requirements for effective game management include information on limiting factors and population losses. This information is needed to set regulations intended to manipulate surplus numbers of game animals in the pursuit of management goals. Violations of regulations and other game laws are limiting factors if they result in the further reduction of numbers of game animals. Because of this, knowledge of the frequency and types of violations is necessary to implement proper management programs. In virtually all jurisdictions, however, this knowledge is missing.

The magnitude of game violations has serious implications in management programs. Their detection and resolution are dependent upon successful enforcement and educational programs. However, there are currently no reliable mechanisms to measure the effectiveness of enforcement programs and their impact in reducing wildlife violations. Therefore, most attempts to measure the actual level of compliance with resource legislation have not been successful.

The most serious violation of wildlife regulations from a biological perspective involves the illegal removal of animals from a population or herd. Unknown illegal removal can be broadly defined as illegal harvest. However, other mortality factors caused by humans such as automobile traffic, environmental pollution and Treaty Indian harvest also play important roles. Some of this mortality is not necessarily illegal, but the extent of this unknown legal harvest is also an important factor that must be understood. This study focuses on the analysis of only one aspect of this problem - the removal of animals through illegal harvest or poaching.

Many researchers have investigated the illegal harvest of big game, particularly deer, in North America. Generally these studies have identified that most illegal harvest occurs at night with the use of lights (i.e. night-lighting); that it occurs mostly in the fall; that it occurs on weekends; occurs mostly on agricultural private land; and that the violator party consists of more than one person (e.g. Vilkitis 1968; Kaminsky and Giles 1974). These findings have helped enforcement agencies in the detection and apprehension of deer poachers, but have not identified the magnitude of the illegal harvest of deer. Therefore, most agencies cannot incorporate in management strategies accurate estimates of the annual mortality rates of animals.

Some studies have used indirect methods in an attempt to estimate the magnitude of the illegal harvest of deer. The majority of these studies have related illegal kills to prosecution reports, recorded public complaints or direct interviews with enforcement officers. The most promising research, however, was conducted by Vilkitis (1968) who pioneered the use of violation simulation techniques.

Violation simulation provides absolute estimates of illegal kill or violations through the use of a "capture-recapture" experiment. The technique uses the ratio of detected violations to known violations by simulating incidents involving illegal harvest activities. Estimates of violations are then derived using the Petersen population index, a formula and methodology originally involved in estimating the size of mobile animal populations.

This technique has been applied in various jurisdictions in the United States (e.g. Idaho (Vilkitis 1968), Maine (Vilkitis 1971), California (Stork and Walgenbach 1973), New Mexico (Pursley 1977) and Michigan (Stoll and Hussain 1979)). These studies have yielded estimates of illegal deer harvest ranging from 50% to 100% of the legal harvest. The only comparable Canadian study was undertaken by Bessey (1983). Bessey calculated that illegal harvest due to night-lighting was only 10-15% of the legal harvest in Manitoba. In all these studies the detection of simulated violations varied from 0 to 2%.

In Alberta, a technically sound estimate of the illegal harvest of deer has not been attempted. However, there has been other research on illegal harvest. Two previous studies investigated the activities of organized illegal market hunting of big game (Special Investigations Unit, 1983a; 1983b). One other study used violation simulation techniques to identify a large number of unreported violations relating to illegal harvest (Boxall et al. 1984).

This Alberta study follows the general methodology employed by previous studies done in the U.S.A. and Manitoba. The earlier violation simulation study by Boxall et al. (1984) served as a pilot project and allowed certain refinements of the methodology. The objective of this study is to identify the magnitude of the illegal harvest of deer over one calendar year in the province, and to relate this estimate to the legal harvest of deer over the same time period.

# METHODS

## A. The Petersen Method

The basic goal of violation simulation studies is to determine a ratio of detected violations to known violations. Numbers of known violations are created through simulating various illegal activities. These violations are called simulations. At some time following the operational construction of simulations, information systems used to log reports of violations are investigated to determine if any simulations were reported to the agency from outside sources. The ratio of known to detected or reported violations can then be calculated.

The information resulting from these activities is similar, in theory, to that gathered from an "animal mark-recapture" experiment. The purpose of such an experiment is the estimation of animal population size. Similarly, the purpose of a violation simulation study is the estimation of a population of violations. In these experiments, individual animals are captured, marked and released into the wild. At a later time, another sample of animals is captured and the ratio of marked to unmarked individuals in the sample is determined. This ratio can be used to estimate the population size of animals.

Supporting these experiments have been numerous mathematical and statistical efforts to investigate ways of improving the accuracy of population estimates (see Seber 1982). Violation simulation studies can use formulae derived from some of these studies. To date, all violation simulation studies have used the Petersen Method. A detailed treatment of the assumptions, calculations and background of the Petersen Method can be found in Appendix 1. A simplified overview of the use of the Petersen Method in this study follows.

The formula used to estimate the total number of illegal harvest violations was:

$$N = \frac{(M + 1)(C + 1)}{(R + 1)} - 1$$

Where N = the estimate of total violations, M = number of simulated violations conducted, C = the number of occurrences of violations reported to the agency's information system and R = the number of simulated violations reported to the information system ("recaptures"). The variance ($V_N$) of this estimate can be approximated by:

$$\text{Variance } (V_N) = \frac{M^2 (C + 1)(C - R)}{(R + 1)^2 (R + 2)} \text{ (Bailey 1951: 296).}$$

The variance was used to determine confidence intervals around the Petersen estimate (Seber 1982). An approximate 95 % confidence interval was calculated by

$$N \pm 1.96 \sqrt{V_N}$$

The Petersen Method involves knowledge of three variables: C, R and M. Their determination in a violation simulation study necessitates some assumptions and other computations. The next section of this chapter discusses assumptions involved in the calculations of C and R. The last section describes how the value for M was derived.

## B. Reports of Violations - The Animal Incident Reporting System

Occurrences of violations reported to the Alberta Fish and Wildlife Division by the public are recorded on the Animal Incident Reporting System (AIRS). This is a computerized database containing information on reported nuisance wildlife, violations, public complaints and environmental problems. Each record contains detailed data on geographical location, species of wildlife involved and specific information on the type of occurrence. In addition to a computer entry for each record, detailed occurrence report forms listing specifics of each occurrence are completed in field offices and filed in headquarters. This system is the only one we are aware of in North America (R. Adams, pers. comm.).

A number of occurrences in AIRS each year involve illegal harvest of deer. The total number of these in the system for 1985 represents C in the formula; the number of violations investigated for simulations. Any of these occurrences that were actually simulations are considered recaptures. Recaptures could be confirmed using the specifics in the occurrence documentation including geographical location, date, characteristics of the incident and related information. These reported simulations were tallied and the resulting total was entered as R in the Petersen formula.

Using AIRS in a violation simulation study necessitates that:

1. detected simulations reported to the agency are actually being recorded in AIRS.
2. all occurrences of illegal harvest in AIRS which are investigated for recaptures of simulated violations can be realistically compared to simulations. In other words the methods of recording occurrences, and mechanisms of information retrieval, are accurate enough to meet

the comparative purposes of the violation simulation study. The records being tallied to obtain C and R must be related to the illegal harvest of deer, and not other violations of wildlife regulations.

To ensure that the first requirement for a technically sound violation simulation study was met by AIRS, another project was conducted concurrently to determine the accuracy of AIRS in recording violations detected and reported by the public. This second study identified that 83% of all violations reported to Alberta Fish and Wildlife offices were recorded on occurrence report forms and were entered into AIRS (Adams 1986). The study also confirmed that the information was accurately reported by division staff on the Occurrence Report Forms. Given that 83% of reported violations are actually recorded in AIRS, the frequencies of occurrences in the variables C and R were multiplied by 1.205 to account for a theoretical 100% reporting rate.

The second requirement was met by comparing a computer analysis of records of illegal harvest from AIRS with a manual inspection of Occurrence Report Forms of these same records. This comparison ensured that only occurrences that were similar in nature to the simulations conducted were compared. Each occurrence record identified by the computer as an illegal deer harvest violation was screened for appropriate species (deer); whether an illegal kill or an attempt at one was actually involved; and if the time period was correct (Jan.-Dec. 1985).

An illegal kill is defined in this study as one the Fish and Wildlife Division could have no knowledge of through harvest surveys, hunter check stations or any other divisional information system. This means that many deer taken and tagged by licensed hunters during the regular season involving illegal activities such as trespassing, or with the use of an illegal calibre weapon for example, were not classified as illegal kills. Any deer properly tagged by a licensed hunter is thus classified as a legal kill. Since the objective of this study was to estimate the magnitude of harvest not likely to be reported to the division, these methods ensured that occurrences in the second sample which were inspected for recaptures (C), were representative of simulations conducted and only involved the poaching of deer.

Only occurrences recorded in AIRS were used in this study. Officers may have known about other violations involving illegal harvest, but unless their knowledge was recorded on an occurrence report form, it did not enter into the analysis.

## C. Simulations

The last term in the Petersen equation is M, the number of simulations conducted. The major conditions upon M for successful use of the Petersen method in violation simulation studies are that:

1) simulations are representative of actual illegal harvest attempts

2) every simulation has an equal chance of detection.

These conditions can be met by standardizing certain operational aspects of the simulations. The first condition requires some knowledge of the activities of actual violators and consistent application of this knowledge in the conduct of simulations. This knowledge was acquired through undercover studies conducted by the Special Investigations Unit (1983a, 1983b). The second condition is difficult to measure. However, consistent application of certain illegal harvest activities associated with each simulation can help to attain a reasonable degree of detectability.

The most important aspect of the operational part of a violation study is to find a person to play the role of the violator (hereafter called operative or agent). Using only one individual rather than several ensures that simulation activities are applied in a consistent manner. The individual used in this study had previous knowledge of illegal harvest activities through actual experiences. He applied this knowledge by taking numerous precautions to ensure he was behaving like a typical violator.

The potential operational aspects of each simulation were investigated in detail before the field aspects of the study were conducted. Previous undercover experiences with violators (Special Investigations Unit, 1983a; 1983b) and violation simulation (Boxall et al. 1984) allowed the construction of a field checksheet on which each simulation and the activities of the agent could be recorded uniformly. The sheet was designed to force the agent to classify each simulation he performed as one of the following types:

1. Actual Kill: These simulations involved the agent actually shooting and killing a deer.
2. Nightlighting: These were instances involving the use of spotlights to detect and/or attract deer after sunset.
3. Daylight Hunting: Involved simulated hunting of deer during the daylight hours.
4. Parts Left Only: These simulations did not involve active hunting; the agent only left physical evidence of an illegally killed deer in a conspicuous location.

These types of simulations were mutually exclusive. For example, if a deer was killed regardless of what else occurred (e.g. nightlighting), it was categorized as an Actual Kill. Any hunting done with lights at night where a deer was not killed was always called Nightlighting. If the agent left a deer head and hide in a field, and fired several gunshots, the simulation would be called Daylight Hunting, not Parts Left Only.

The agent also recorded certain activities he performed for each simulation. These activities included: firing shots, leaving parts of deer, chasing deer and trespassing. Thus, the agent could trespass in a field, use a spotlight, fire several shots and leave a head and hide of a deer at the site. These actions should provide strong evidence of illegal activity. They may also influence the probability of the simulation being detected.

The checksheet also allowed the agent to record observations such as: when deer were seen, immediate reactions by landowners or casual observers of the simulations and information about illegal possession of wildlife. In addition, certain entries on the form could help the agent match the simulations to occurrence reports while searching for recaptures after the study's completion.

At times, the agent was observed by landowners or other citizens while conducting a simulation. Recording this on the checksheet involved judgment on the part of the agent. If he was observed, information on the reaction of the observer to the activities of the agent was recorded. The agent was also required to record whether cattle, buildings or people were present within an arbitrary distance of 400 m from the simulation location. These human-related factors are thought to possibly influence the probability of an observer reporting the simulation to the authorities.

To provide reliable estimates of illegal harvest, the number of simulations to be performed was determined in advance. The following formula was used to derive this sample size (derived from Overton 1971):

$$M = \frac{z^2 N}{Cp^2}$$

where N = an estimate of illegal harvest attempts; p = the desired degree of precision (i.e. N will be 100%p of the true value); z = 1.96, the standard normal deviate for 95% confidence; C = the number of occurrences from AIRS relating to illegal harvest of deer (it is the same as C in the Petersen formula); M = the number of simulations to be conducted. Solving this equation for M gives the number of simulations to be conducted.

Prior determination of sample size requires a preliminary estimate of illegal harvest attempts of deer (N) and of the number of relevant occurrences from AIRS (C). The only knowledge of these variables comes from a previous violation simulation study conducted during several months in 1983 by Boxall et al. (1984). This study suggested that about 15% of illegal acts relating to wildlife were reported to the division. This percentage was used to calculate a preliminary estimate of the annual illegal harvest of deer using the number of occurrences of illegal deer harvest activities reported to the Fish and Wildlife Division during 1982-83 and 1983-84. These figures and estimates are shown in Table 1. These data suggest that there are about 1,000 occurrences of illegal harvest of deer reported each year and that this translates into 7,000 actual occurrences. Thus preliminary estimates of N and C are 7,000 and 1,000 occurrences respectively.

Using these estimates of C and N in the equation, and selecting a level of precision of 25% (i.e. p = 0.25; N will be within 25% of the true N, 95% of the time), the number of simulations to be performed (M) was calculated as 430. This number was arbitrarily increased to 504 in case the number of occurrences

## TABLE 1

## THE FREQUENCY OF OCCURRENCES OF ILLEGAL HUNTING INVOLVING DEER IN ALBERTA FROM THE AIR SYSTEM

| Month | Number of Occurrences from AIR System | | | Estimated Actual No. of Occurrences* |
|---|---|---|---|---|
| | Illegal Deer Hunting | Nightlighting | Total | |
| 1982/83 | | | | |
| April | 41 | 6 | 47 ( 5%) | 313 |
| May | 38 | 5 | 43 ( 5%) | 287 |
| June | 19 | 2 | 21 ( 2%) | 140 |
| July | 21 | 9 | 30 ( 3%) | 200 |
| August | 15 | 20 | 35 ( 4%) | 233 |
| Sept. | 44 | 47 | 91 ( 9%) | 607 |
| Oct. | 102 | 137 | 239 (24%) | 1,593 |
| Nov. | 167 | 144 | 311 (31%) | 2,073 |
| Dec. | 31 | 30 | 61 ( 6%) | 407 |
| Jan. | 37 | 15 | 52 ( 5%) | 347 |
| Feb. | 29 | 9 | 38 ( 4%) | 253 |
| March | 19 | 5 | 24 ( 2%) | 160 |
| Totals | 563 | 429 | 992 (100%) | 6,613 |
| 1983/84 | | | | |
| April | 31 | 3 | 34 ( 3%) | 227 |
| May | 34 | 4 | 38 ( 4%) | 253 |
| June | 24 | 5 | 29 ( 3%) | 193 |
| July | 34 | 5 | 39 ( 4%) | 260 |
| August | 26 | 14 | 40 ( 4%) | 267 |
| Sept. | 59 | 78 | 137 (13%) | 913 |
| Oct. | 93 | 124 | 217 (20%) | 1,447 |
| Nov. | 200 | 171 | 371 (35%) | 2,473 |
| Dec. | 42 | 29 | 71 ( 7%) | 473 |
| Jan. | 30 | 11 | 41 ( 4%) | 273 |
| Feb. | 23 | 7 | 30 ( 2%) | 200 |
| March | 20 | 4 | 24 ( 2%) | 160 |
| Totals | 616 | 455 | 1,071 (101%) | 7,139 |

* The estimation of actual frequencies was determined by assuming that 15% of occurrences are reported to the division and subsequently appear on the AIR system. This figure was determined in a previous study on illegal hunting activity (see Boxall, Melnyk and Cormier 1984).

reported in 1985 was lower than 1,000, and to yield a number divisible by 12 to give equal monthly samples (42 simulations). The agent was advised that 504 was to be the minimum sample size and that any opportunity to carry out more should be taken.

The last operational aspect of the study was to provide an indication of where simulations should be conducted to ensure that a truly provincial estimate was possible. For this purpose it was assumed that violators would operate in areas where deer were more likely to be found. Since this assumption could be false on a micro-geographic scale, the agent was able to simulate illegal harvest attempts where there was physical evidence of deer. However, on a macro-geographic scale the agent was directed to conduct a certain percentage of the total simulations in each Fish and Wildlife administrative region. The percentages were based upon the estimated numbers of deer in each region (unpublished data, Fish and Wildlife Division). These estimates were converted to percentages of the total numbers of deer in the province, and simulations followed this percentage distribution:

1. 60% of all simulations were to be conducted east of the foothills and between Calgary in the south and the town of Athabasca in the north.
2. About 15% should occur in the parkland areas of central Alberta.
3. 15% should be conducted south of Calgary in the prairie areas.
4. 10% should be occurring in the foothills and mountainous areas of the province.

The extreme northern areas of the province were not used because of low numbers of deer and people, poor accessibility and high costs.

# RESULTS

## A. Field Operations

During 1985, 649 simulations were conducted throughout the province. The first simulation occurred on 25 January in central Alberta; the last was on 30 November in the St. Paul area. During the year, the agent's activities were reported only seven times to the Fish and Wildlife Division. These seven reports indicate a reporting rate of 1.1%.

Table 2 displays frequencies of the various types of simulations. Of the 649 total, 424 (65%) were categorized by the agent as simulated daytime hunting. Nightlighting simulations were performed on 202 occasions or 31% of the time. There were a total of 13 (2%) actual kills and 10 (2%) parts left only simulations.

Of all the activities performed by the agent, shots fired, deer chased and parts left were the activities most frequently simulated to portray illegal hunting. The frequencies of these activities are reported in Table 2. Shots were fired during 89% of daytime simulations and 79% of nightlighting simulations. Deer were chased by the agent in 124 simulations; mostly during daylight. These activities point to evidence of attempts at illegal harvest. Parts of deer, which were left in 16% of all simulations (Table 2), were intended to provide evidence of an illegal kill.

The agent also recorded observations of deer while conducting simulations and information about the land around the simulation site. Some of these findings are summarized in Table 3. The agent trespassed during 88% of all simulations, including 29 times (5%) on posted land. Deer were seen in 35% of all simulations and at least one could have been shot in 27% of them. Observations of deer were more frequent during nightlighting than daytime hunting (Table 3). However, the differences between the frequencies are not statistically significant (Chi-square values are 0.04 and 0.06 respectively, $P > 0.80$).

## TABLE 2

## FREQUENCIES OF TYPES OF SIMULATIONS AND ACTIVITIES PERFORMED DURING THOSE SIMULATIONS

| ACTIVITY | TYPE OF SIMULATION | | | | |
|---|---|---|---|---|---|
| | ACTUAL KILL | NIGHTLIGHTING | DAYTIME HUNTING | PARTS LEFT | TOTAL |
| Shots Fired | 13 (100%) | 159 (79%) | 378 (89%) | 0 (0%) | 550 (85%) |
| Chased Deer | 1 (8%) | 14 (7%) | 109 (26%) | 0 (0%) | 124 (19%) |
| Parts Left | 13 (100%) | 18 (9%) | 65 (15%) | 10 (100%) | 106 (16%) |
| Total | 13 | 202 | 424 | 10 | 649 |

## TABLE 3

## FREQUENCIES OF OBSERVATIONS AND OTHER ACTIVITIES RECORDED BY THE AGENT DURING SIMULATIONS

| RECORDED OBSERVATION OR ACTIVITY | TYPE OF SIMULATION | | | | |
|---|---|---|---|---|---|
| | ACTUAL KILL | NIGHTLIGHTING | DAYTIME HUNTING | PARTS LEFT | TOTAL |
| Trespassed | 9 (69%) | 167 (83%) | 384 (91%) | 9 (90%) | 569 (88%) |
| Posted Land | 0 (0%) | 1 (1%) | 27 (6%) | 1 (10%) | 29 (5%) |
| Game Seen | 6 (46%) | 72 (36%) | 146 (34%) | 0 (0%) | 224 (35%) |
| Could Have Shot Game | 1 (8%) | 57 (28%) | 114 (27%) | 0 (0%) | 172 (27%) |
| Parts Left | 13 (100%) | 18 (9%) | 65 (15%) | 2 (20%) | 98 (15%) |
| Blood Trail | 12 (92%) | 6 (3%) | 27 (6%) | 7 (70%) | 52 (8%) |
| Gutpile Left | 10 (77%) | 13 (6%) | 43 (10%) | 1 (10%) | 67 (10%) |
| Hide Left | 10 (77%) | 5 (3%) | 10 (2%) | 5 (50%) | 30 (5%) |
| Legs Left | 5 (39%) | 4 (2%) | 10 (2%) | 3 (30%) | 22 (3%) |
| Total | 13 | 202 | 424 | 10 | 649 |

The agent endeavored to leave animal parts in all types of simulations including 15% of daytime and 9% of nightlighting actions. During simulations where a deer was actually killed, the agent always left some parts of the animal behind. Some parts were saved and used in other simulations. Other deer which were found dead during the study by the agent or Fish and Wildlife officers were also used. Parts of the animal which were used included internal organs (viscera), heads, hides and legs. Internal organs were left most often (10%) followed by hides (5%), then one or more legs (4%) (Table 3). In 52 simulations (8%) a blood trail was made. This was intended to show where a shot animal was dragged into a vehicle.

The majority of simulations were conducted between March and August of 1985. Over 26% occurred during March/April, 24% in July/August and 21% in May/June. During the periods January/February and October/November few simulations were conducted; only 14% and 15% respectively. In the case of October/November, the difficulty in discriminating between legal and illegal kills by officers and the general public was the reason few were performed. Figure 1 depicts provincial distributions of simulations for the months mentioned above.

During the periods of January/February and March through June the agent focused on daytime simulations (Table 4). About two-thirds of the simulations performed during January/February were daytime simulations, while 85% of the simulations conducted between March and June were daytime simulations. In July and August about 60% of the simulations conducted were during the daylight hours. However, during the fall months, the majority of simulations involved nightlighting (88%). Associated with these simulations only obvious illegal actions were undertaken. Thus, illegal activities during the actual hunting season represented obvious infractions.

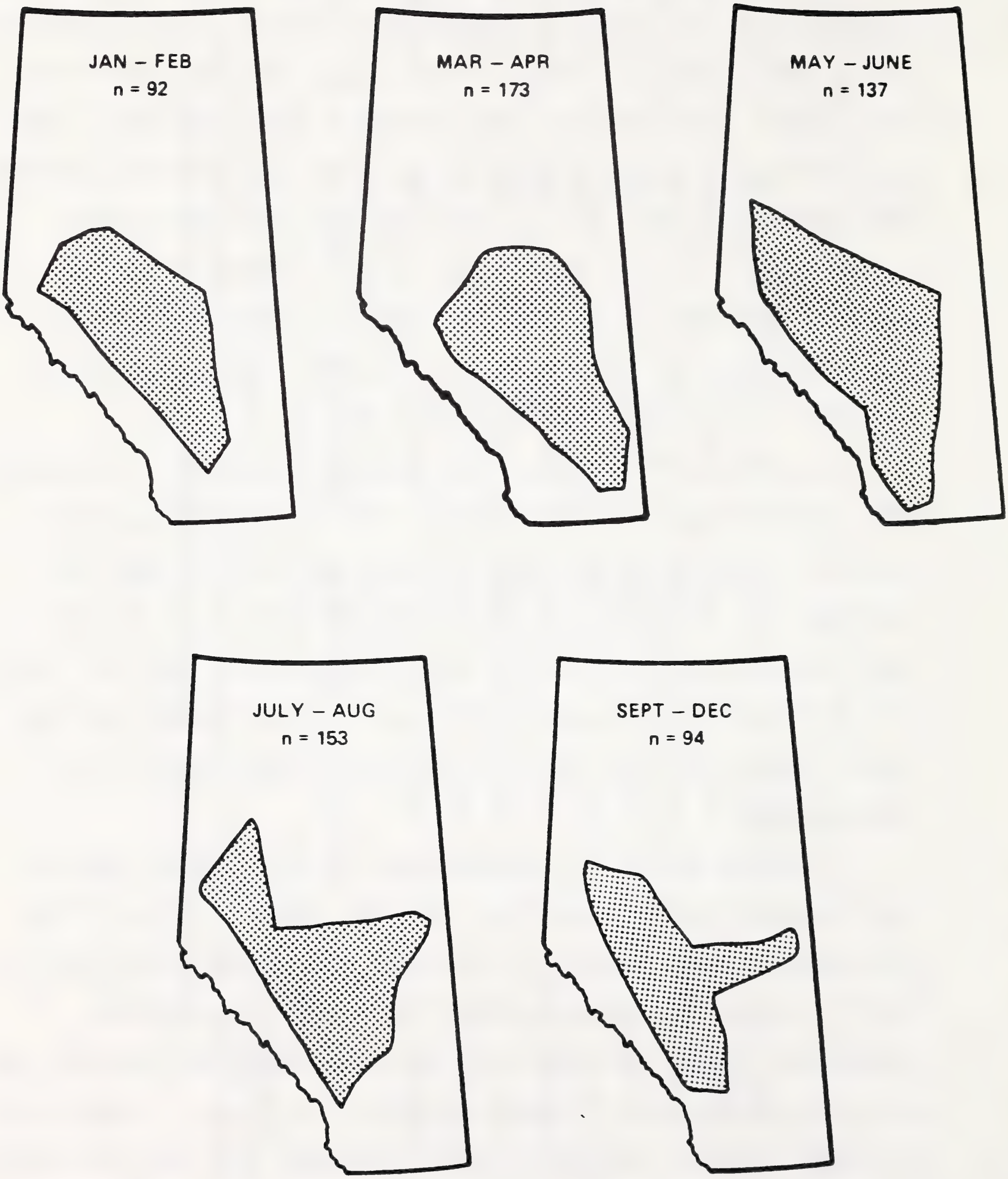


Figure 1. Geographical Distribution of Simulations by Seasonal Time Period

## TABLE 4

## FREQUENCIES OF SIMULATIONS BY TWO-MONTH PERIODS

| SIMULATION TYPE | JANUARY FEBRUARY | MARCH APRIL | MAY JUNE | JULY AUGUST | OCTOBER NOVEMBER |
|---|---|---|---|---|---|
| Actual Kill | 3<br>(3%) | 4<br>(2%) | 3<br>(2%) | 1<br>(1%) | 2<br>(2%) |
| Nightlighting | 27<br>(29%) | 28<br>(16%) | 7<br>(5%) | 57<br>(37%) | 83<br>(88%) |
| Daytime Hunting | 62<br>(67%) | 141<br>(82%) | 122<br>(89%) | 91<br>(60%) | 8<br>(9%) |
| Parts Left Only | 0<br>(0%) | 0<br>(0%) | 5<br>(4%) | 4<br>(3%) | 1<br>(1%) |
| Total | 92<br>(99%) | 173<br>(100%) | 137<br>(100%) | 153<br>(101%) | 94<br>(100%) |

Simulations were conducted throughout the province except in the extreme northeast and northwest areas (Figure 1). Most simulations were performed in the Central (28%) and the Northeast Administrative regions (26%), fewer in the Peace River (18%), East Slopes (16%), and Southern regions (12%).

As mentioned in the previous chapter, the agent recorded the presence of people, buildings, and livestock within 400 m of the simulation site. In 63% of the simulations conducted, one or more of these were present (Table 5). Buildings were present most often during a simulation (54%), followed by livestock (27%), then people (20%). These percentages were similar regardless of the type of simulation involved (Table 5).

The agent also recorded whether he had been observed conducting a simulation. Examples of such situations included: people being nearby (possibly in an adjacent field) and able to see spotlights or hear gun shots; people in vehicles driving by an open field posted "No Hunting or Trespassing" in which the agent was driving at night or during the day; and incidents where landowners or others actually pursued the agent during the simulation. In the agent's estimation, he was observed during 139 (24%) simulations. However, in only three instances was the simulation reported to the Fish and Wildlife Division. One of these was a nightlighting simulation, the other two were daytime simulations.

The seven simulations reported involved the agent firing shots and trespassing where people, buildings or livestock were present at the simulation site (Table 6). These seven simulations were reported after an average of approximately four days. Five of the seven reports occurred during the summer months (June to August) while the remaining two occurred in January.

## TABLE 5

## FREQUENCIES OF HUMAN RELATED FACTORS PRESENT DURING SIMULATIONS

| FACTORS | TYPE OF SIMULATION | | | | |
|---|---|---|---|---|---|
| | ACTUAL KILL | NIGHTLIGHTING | DAYTIME HUNTING | PARTS LEFT | TOTAL |
| Livestock Present | 4 (31%) | 51 (25%) | 115 (27%) | 3 (30%) | 173 (27%) |
| Buildings Present | 7 (54%) | 109 (54%) | 230 (54%) | 7 (70%) | 353 (54%) |
| People Present | 4 (31%) | 39 (19%) | 85 (20%) | 4 (40%) | 132 (20%) |
| At Least One Human Factor Present | 8 (62%) | 127 (63%) | 265 (63%) | 8 (80%) | 408 (63%) |
| Agent Observed | 2 (15%) | 41 (20%) | 95 (22%) | 1 (10%) | 139 (21%) |
| Total | 13 | 202 | 424 | 10 | 649 |

These seven reports, in conjunction with the agent's field notes, cannot be used to identify specific activities occurring during an illegal harvest attempt that result in a report by the public to the division. From Table 6 it is evident that certain activities (i.e. shots, human-related factors) occurring during a simulation were not always the primary reasons a member of the public made a report. Rather it appears that chance, the initiative of the observer, and the agent taking risks, combined to result in a simulation being reported. In support of this conclusion is a large number of unreported simulations that were conducted with activities or human-related factors similar to those of the seven reported simulations.

The following two passages from the agent's field notes serve to illustrate examples of typical simulations. The first describes a daytime simulation which was reported to the division (see first entry in Table 6). The second summarizes a nightlighting simulation where the agent was observed but not reported.

1. January 27, 1985 10:55 Central Alberta.

   "I drove into a stubble field where a farmer has been going in to pick up straw bales. I spotted a deer and chased it with my vehicle into some trees on the north side of the field. I took a couple of shots while doing this. I then left a gutpile close to the bales and left the area."

Simulation reported February 1, 1985.

# TABLE 6

## SUMMARY OF SIMULATIONS REPORTED TO THE FISH AND WILDLIFE DIVISION

| DATE OF SIMULATION | DATE REPORTED | REGION | DISTRICT | DESCRIPTION OF SIMULATION | PROBABLE FACTORS THAT LED TO REPORTING |
|---|---|---|---|---|---|
| Jan. 27, 1985<br>Jan. 27, 1985 | Feb. 2, 1985 | Northeast | Barrhead | daytime hunting, shots, trespassing, parts left, buildings present, observed | - reported chiefly due to other suspected illegal activity in the area (late at night),<br>- these two simulations were done during the day, and were not specifically mentioned. |
| June 5, 1985 | June 6, 1985 | Peace River | Grande Prairie | daytime hunting, shots, trespassing, parts left, buildings present | - parts left by agent (head) discovered near granary |
| July 19, 1985 | July 30, 1985 | Central | Ponoka | daytime hunting, shots, trespassing, buildings, people present, observed | - farmer heard shots and saw agent<br>- licence plate number reported |
| July 30, 1985 | July 31, 1985 | East Slopes | Evansburg | daytime hunting, shots, trespassing, buildings, livestock present | - gate left open and tracks in uncut hayfield reported |
| Aug. 9, 1985 | Aug. 13, 1985 | Peace River | Valleyview | daytime hunting, shots, trespassing, parts left, buildings present | - deer carcass hung on a tree at a campsite reported |
| Aug. 14, 1985 | Aug. 14, 1985 | Central | Hanna | nightlighting, shots, trespassing, people, buildings, livestock present, observed | - while chasing and spotlighting a deer, agent was observed |

2. October 16, 1985 23:40 Peace River area.

> "Opened the gate and drove into a pasture. As I drove I spotlighted the entire area. Then I got onto a large hill where I could see all over and I took one shot. Then I drove around more, slowly spotlighting. I observed a vehicle nearby; it could easily see me. I shut off all my lights and sat there. The vehicle slowly crept by me. I then drove out and left the area."

The division has no record of this simulation being reported.

These two cases are generally representative of the simulations performed. In many incidents the agent could have been apprehended and in fact was confronted by a member of the public twice and pursued by people six times. In other simulations, the agent appeared to provide opportunity to be observed. However, these two examples serve to illustrate the kinds of activities that occur during a simulation and underscore the notion that illegal hunting is seldom reported to the division, despite being observed by the public.

### B. Reports of Illegal Hunting of Deer to the Division

During 1985 the Fish and Wildlife Division received 736 reports from the public of illegal hunting activity involving deer (see Appendix 2). Upon closer examination it was determined that 481 of these occurrences directly resembled the activities performed during a simulation. The remaining 255 occurrences were excluded because they involved such things as suspected and confirmed dead animals resulting from automobile collisions or Treaty Indian harvest.

### TABLE 7

### CHARACTERISTICS OF ACTUAL OCCURRENCES OF ILLEGAL DEER HUNTING REPORTED TO THE FISH AND WILDLIFE DIVISION DURING 1985

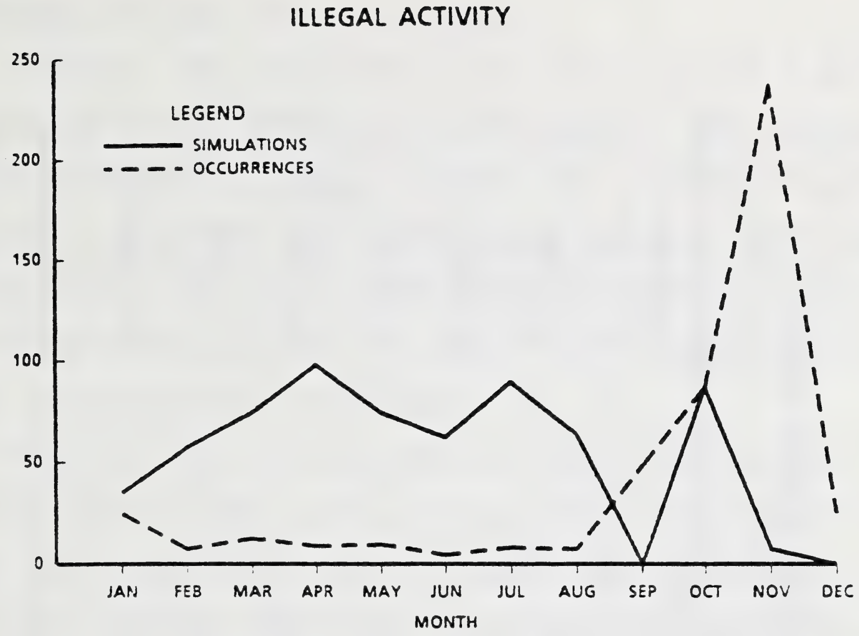
| TYPE OF ILLEGAL ACTIVITY | | |
|---|---|---|
| Hunting | 90 | (19%) |
| Harvest | 391 | (82%) |
| Total | 481 | (101%) |
| **TIME OF DAY** | | |
| Daytime | 256 | (53%) |
| Nightlighting | 225 | (47%) |
| Total | 481 | (100%) |
| **TIME OF YEAR** | | |
| Hunting Season | 372 | (77%) |
| Closed Season | 109 | (23%) |
| Total | 481 | (100%) |

Each of the 481 occurrences was manually examined to obtain the following information: (i) evidence of illegal harvest (an actual kill); (ii) nightlighting or daytime hunting; and (iii) whether the incident occurred during the hunting season (October and November) or closed season (Table 7). For 227 occurrences it was impossible to ascertain if the illegal activity occurred during the day or night. It was assumed that the same proportion of these missing cases occurred during the day (or night) as was determined from the other 254 occurrences.

Of the 481 occurrences alleging illegal activity, 391 (81%) involved the illegal harvest of at least one deer while the remaining 19% related to the illegal hunting of deer. An estimated 586 illegally killed deer were reported to the division. Nightlighting incidents accounted for almost 50% of the 481 occurrences (225; 47%).

Throughout 1985 the number of reports concerning illegal hunting increased dramatically in the autumn months, especially during the hunting season (October and November). For example, November alone accounted for 49% of all occurrences of illegal hunting activity reported during that year. In contrast most of the simulations were conducted during the spring and summer months. From January to October, with the exception of a hiatus in September, simulated illegal harvest activities were conducted with consistent intensity. Reports of actual illegal activity did not follow this pattern. Figure 2 depicts these differences in greater detail.

On a regional basis most reported occurrences originated in the Central (40%) and Northeast (25%) Administrative regions. This percentage distribution of occurrences by region is similar to that of simulated illegal hunting activity as performed by the agent (Table 8).



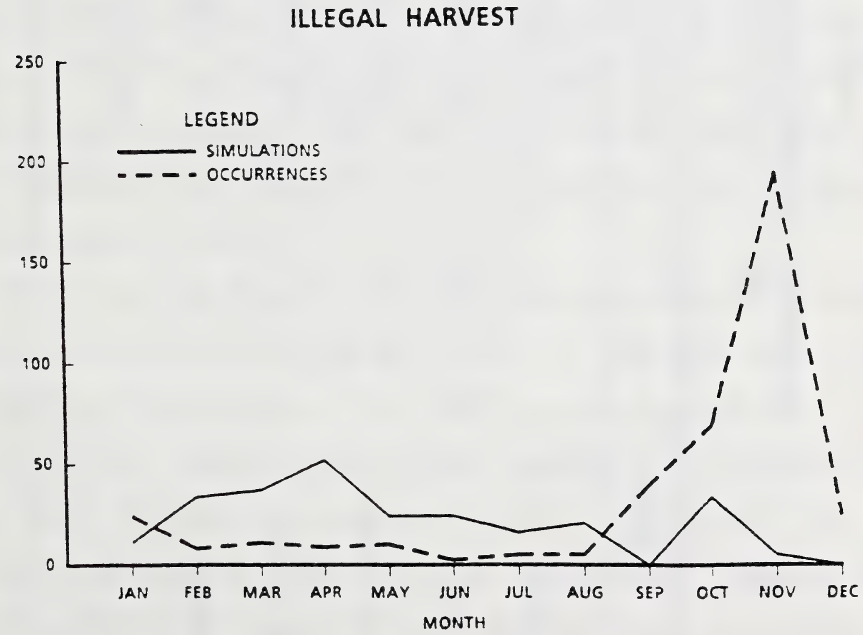


Figure 2. Numbers of Reports of Occurrences of Illegal Activity and Simulations by Month.

## TABLE 8

### THE DISTRIBUTIONS OF SIMULATIONS AND ACTUAL REPORTED ILLEGAL ACTIVITY BY ADMINISTRATIVE REGION

| REGION | SIMULATIONS | OCCURRENCES |
|---|---|---|
| Southern | 78 (12%) | 57 (12%) |
| Central | 179 (28%) | 191 (40%) |
| Eastern Slopes | 103 (16%) | 73 (15%) |
| Peace River | 118 (18%) | 41 (9%) |
| Northeast | 171 (26%) | 119 (25%) |
| Total | 649 (100%) | 481 (101%) |

### C. Estimates of Illegal Activity and Harvest

Estimates of the frequency of illegal activity relating to deer during 1985 using the Petersen formula are shown in Figure 3. These estimates describe the magnitude of attempts to harvest deer. They do not provide an indication of the harvest. During 1985, between 15,946 and 64,078 instances of illegal hunting involving deer were estimated to have taken place (Figure 3). The midpoint of this range is 40,012 and the 95% confidence interval is 24,066, almost two-thirds of the midpoint.

Comparisons of estimates derived using actual occurrences and simulations that took place during the legal hunting season (October and November) with other times of the year, suggest that illegal activity occurred more frequently during the hunting season. The exact amount, although estimated in Figure 3, is not considered reliable due to the low numbers of simulations conducted (38) and no reports of these simulations. Therefore, the magnitude of illegal activity during the closed season is lower. Estimates range from 3,141 to 12,451 occurrences with a midpoint of 7,796 occurrences (Figure 3).

Illegal hunting of deer during 1985 was estimated to be twice as frequent at night than during the day (Figure 3). The total number of nightlighting incidents during all of 1985 was computed at 29,444 (± 27,252). The few reports of simulations are largely responsible for wide variation in this estimate. Daytime hunting was calculated at less than half the nightlighting estimate with 12,429 (± 8,467) occurrences. Comparing the frequencies of these two types of illegal hunting during the hunting and non-hunting seasons is difficult due to the lack of adequate numbers of simulations and captures. Estimates are more precise for the non-hunting

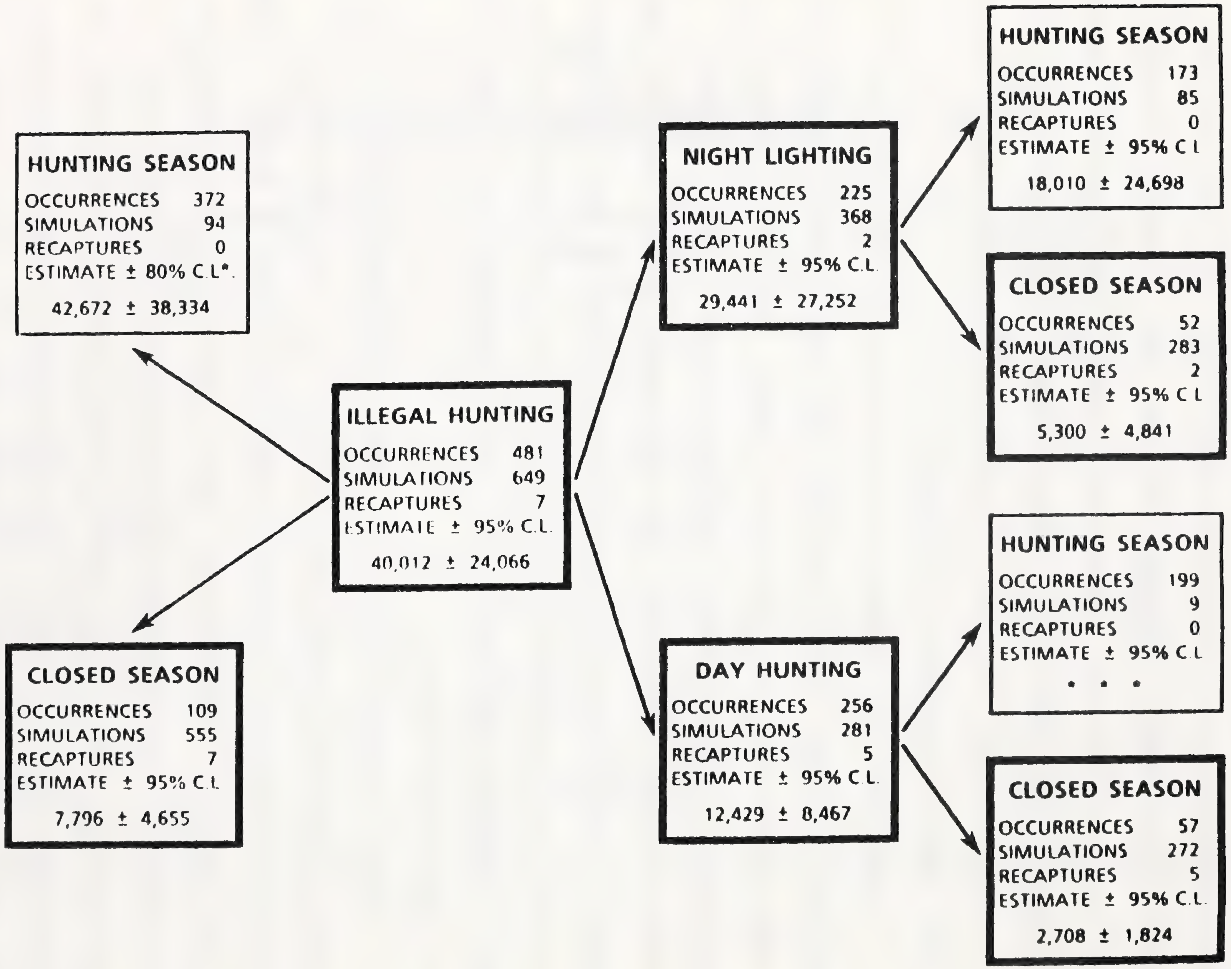


Figure 3. Estimates of Illegal Activity Involving Deer in Alberta During 1985.

*** Signifies that the calculated estimate is not valid because of few simulations and 0 recaptures.

* Indicates an 80% confidence limit.

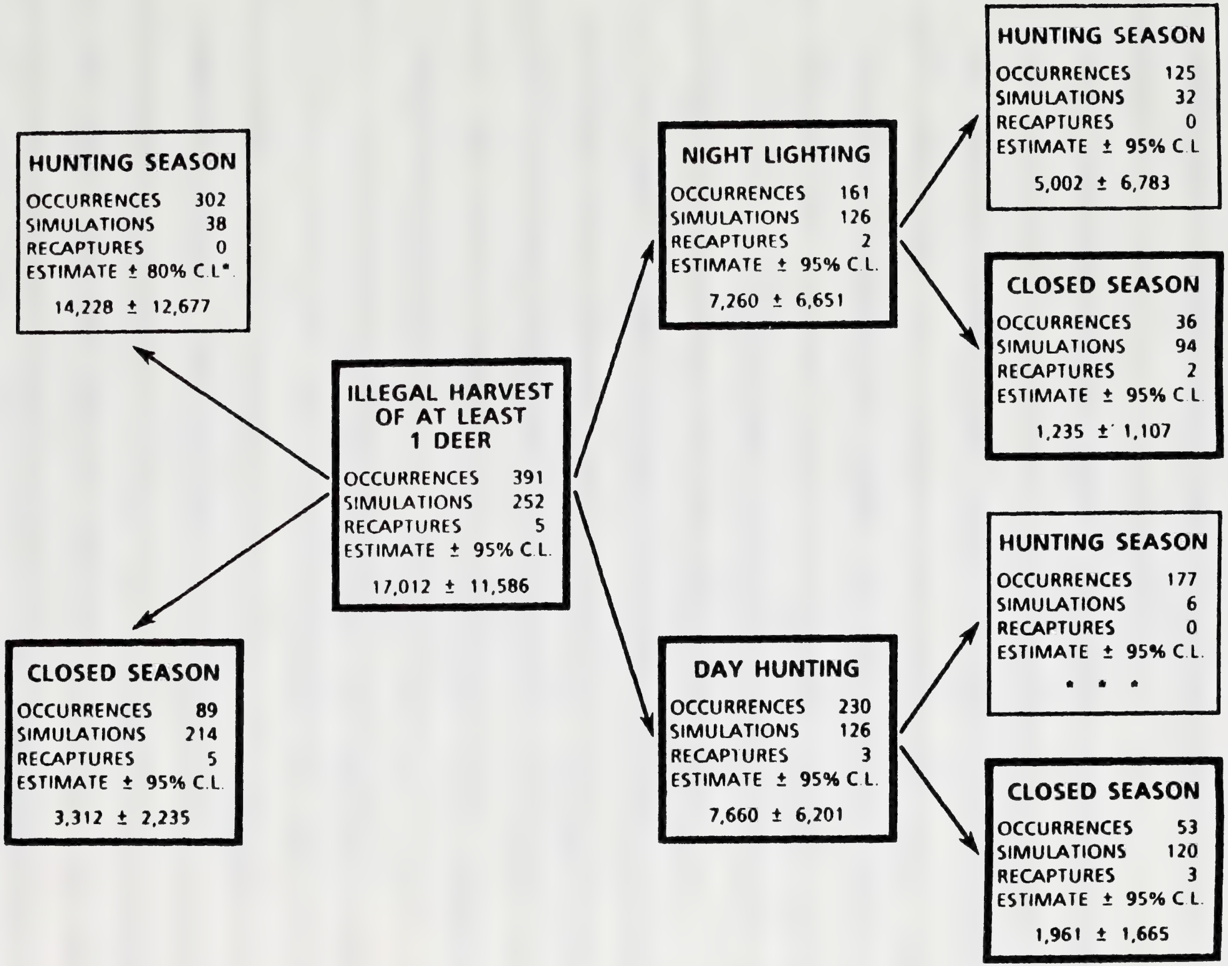


Figure 4. Estimate of Illegal Harvest of Deer in Alberta During 1985.

*** Signifies that the calculated estimate is not valid because of few simulations and 0 recaptures.

* Indicates an 80% confidence limit.

season where between 459 and 10,141 occurrences of nightlighting and between 884 and 4,532 occurrences of daytime hunting were calculated.

Estimates of the illegal harvest of deer (Figure 4) were derived using two numbers. First, actual incidents of illegal activity which had genuine evidence of dead deer. Second, the number of simulations which had the following characteristics: an actual kill simulation type or parts left as a simulation activity (Table 2), and any simulation where the agent felt certain he could have shot at least one deer. These requirements yielded 391 occurrences and 252 simulations (13 actual kills, 98 parts left and 141 instances where deer could have been shot). There were five reports of these simulations (Figure 4), all during the closed season.

The estimate and associated 95% confidence interval of illegal harvest attempts involving the killing of at least one deer per attempt was 17,012 ± 11,586 (Figure 4). The estimate of illegal harvest attempts during the closed season time period only, was calculated to be between 1,077 to 5,547 occurrences. The hunting season estimate is more than four times higher and has a very wide confidence interval. A reasonably precise estimate of illegal harvest during the hunting season is not available due to low numbers of simulations and recaptures.

Estimates of illegal harvest by night and day during 1985 were each calculated to be over 7,000 occurrences (Figure 4). Given the estimated frequencies of illegal activity (Figure 3), it appears that daytime hunting is more successful than nightlighting. However, it must be emphasized that the harvest estimates involve attempts where at least one deer was harvested. Nightlighting could yield a higher number of deer harvested per occurrence. For example, the actual occurrences on AIRS from 1985 identify that 1.2 deer were killed per nightlighting occurrence while 1.1 deer were killed per daylight hunting occurrence. These rates of deer killed are not statistically significant (t test, P > 0.19). However, further research is necessary to identify the significance of illegal hunting at night and during the day.

An accurate estimate of the number of deer harvested illegally during 1985 is difficult. It is assumed that at a minimum between 5,426 and 28,598 deer were killed illegally (see Figure 4). To adjust this number to account for possibilities of harvesting more than one deer per illegal hunting occurrence, two methods can be used. The first involves using the average number of deer killed from appropriate occurrences reported to the Division (AIRS) during 1985. The second involves the opinion of the agent - the average number of deer per simulation that could have been shot.

Table 9 provides the average number of deer harvested per actual occurrence, the hypothetical average kill per simulation and the results of multiplying these values by the estimated number of occurrences (from Figure 4). These products identify that illegal harvest could be as high as 8,221 - 49,671 deer during 1985.

Up to this point, illegal harvest has not been assigned to either one of the two resident deer species, white-tailed and mule deer. Mule deer are considered the easier of the two to kill due to their high detectability and gregarious behaviour. The observations of the agent while conducting simulations and the reports of actual incidents to the division confirm this view. During the study, the agent could have shot 260 deer, 143 (55%) of which were mule deer, 90 (35%) were white-tailed deer and the remainder (27) were unidentified. Thus, mule deer comprise over 60% of the deer that the agent could identify and shoot. The actual incidents of illegal deer harvest reported to the division during 1985 involved 485 deer, of which 376 could be

## TABLE 9

## ESTIMATES OF THE ILLEGAL HARVEST OF DEER DURING 1985

|  | Estimated Number of Occurrences Where At Least One Deer Was Killed (± 95% C.L.) | Average Number of Deer Killed Per Occurrence | Estimated Number of Deer Killed in 1985 Through Illegal Harvest Activities |
|---|---|---|---|
| Simulations (N = 172) (Where the agent could have shot a deer) | 17,012 ± 11,586 | 1.51 | 25,716 ± 17,495 |
| Occurrences (N = 391) (Where at least one deer was killed) | 17,012 ± 11,586 | 1.24 | 21,095 ± 14,367 |

identified as one of the two species. Mule deer comprise 225 (60%) of these animals while whitetails totalled 151 (40%). This information suggests that the majority of illegal harvest of deer involves mule deer in Alberta.

## DISCUSSION

### A. Major Findings

This study has generated two major findings. The first is that 1% of total illegal activity is being reported to the Fish and Wildlife Division. The second finding is the estimate of the magnitude of the annual illegal harvest of deer. Each of these results will be discussed in detail below.

### 1. The 1% Reporting Rate of Violations

Based upon the 1% reporting rate, it is estimated that over 40,000 occurrences of illegal activity relating to deer actually took place in Alberta during 1985. This is a significant quantity of illegal activity considering that this estimate only involves deer. The reporting rates of illegal activity for other big game species are likely different due to factors such as: animal numbers, detectability, proximity to human populations and whether the species is viewed as nuisance wildlife.

Although the estimation of the temporal distribution of this illegal activity was not the objective of this study, efforts were made to determine what times of the day and year illegal harvest attempts were likely to occur. It is suggested that illegal hunting occurs twice as frequently at night than during the day. Limited data also suggest that illegal activity during the hunting season (October to November) is more frequent than during other times of the year.

This latter suggestion is suspect in light of the results of undercover operations conducted by the Special Investigations Unit of the Fish and Wildlife Division. The undercover studies (Special Investigations Unit 1983a, 1983b) revealed that a significant amount of illegal market hunting and trafficking of deer occurs between December and March. Most of this hunting took place on private lands.

These observations are in contrast to the temporal distributions of reports of illegal activity (Figure 2). The vast majority of occurrences are reported in October - November, during the legal hunting season.

On the surface one might suspect that these violations are not observed very often by the public. The undercover agents did find that these violators took numerous precautions to ensure that they were not easily observed. The agent conducting simulations also tried not to be observed. However, members of the public did observe simulations during this study and the previous one (Boxall et al. 1984). Very few of these simulations were ever reported.

Other explanations for the lack of reports of illegal activity are: (i) the public is not aware of what illegal activity is; (ii) the public is not willing to report violators because they could be friends or neighbors; (iii) the public does not consider illegal harvest significant enough to report; (iv) the public has negative attitudes towards wildlife. Elucidation of these suggestions is beyond the scope of this study but should be considered for future research.

## 2. Estimate of the Number of Deer Killed Illegally

This study has derived a number of different measures of illegal harvest of deer (Figures 4 and Table 9). The reliability of these should be discussed and a single value should be chosen for planning purposes.

The first estimate is 17,012 (± 11,586) deer. It is an estimate of the number of occurrences involving the death of at least one deer. This could be viewed as conservative due to the possibilities of multiple kills per illegal hunting occurrence. The other estimates of illegal harvest involve adjusting the 17,012 deer by multiplying by: (i) the average number of deer killed per occurrence involving deer harvest (1.24); or (ii) the average number of deer the agent felt he could have shot per simulation (1.51). These products result in an adjusted estimate of over 20,000 deer (Table 9).

Given the wide 95% confidence interval on the original Petersen estimate of 17,012 (Figure 4) it is suggested that the multiplication to adjust the deer harvest estimates per attempt is unnecessary. The original estimate should probably be used as the illegal harvest estimate since it does not generate further sources of error induced by the multiplication.

Before accepting the value of 17,012 as a reasonable measure of illegal harvest, however, it is important to review the accuracy of the variables used in the Petersen formula. The calculation involves three variables: M, the number of simulations; C, the number of occurrences on the AIR system used to search for simulation recaptures; and R, the number of recaptures of simulations found in the AIR system.

Measures of the two variables involving the AIR system (C and R) were determined as accurately as possible given current technology and manpower. For example, occurrences were manually inspected by the agent for recaptures at least twice before they were entered in the computer system. Each occurrence identified as relevant to this study (i.e. a possible component of C), was manually inspected by the authors to ensure accuracy and that its inclusion was logical. In addition, a concurrent study (Adams 1986) identified an error term on recording reports of occurrences, and that recorded occurrences reflected the information that was related to the division's staff.

The largest source of bias in the Petersen formula lies with the third variable, M. Its value was obtained by including only those simulations where actual evidence of a dead deer was left, or by including cases where the agent felt he could have shot a deer. Possible weakness could be the result of the agent's estimation of success in simulations where he considered he could have shot a deer. Since 111 of the 252 simulations used in this calculation (Figure 4) had direct evidence of dead deer, variation in the estimate of illegal harvest must involve the remaining 141 simulations.

To investigate the significance of this possibility, the Petersen estimate was modelled, holding C and R constant while varying M. Figure 5 provides an indication of the sensitivity of the Petersen estimate of illegal harvest to changes in M. An error of 10% in the value of M (225 instead of 250) only reduces the illegal harvest estimate to over 15,000 deer. A reduction of M by 100 simulations still produces an estimate in excess of 10,000 deer. These results suggest that despite possible errors in M, the measure of illegal harvest is still of a considerable magnitude.

## B. Illegal Harvest Compared to Legal Harvest by Sport Hunters

One of the important questions asked of illegal harvest is its significance in relation to the legal harvest. This is where a measure of illegal harvest assumes importance with respect to its order of magnitude. Table 10 compares estimates of the 1985 harvest of deer by licensed hunters and the illegal harvest derived from this study. The estimate of 17,012 is about 44% of the estimated legal harvest of 38,447 deer during 1985.

Assessments of illegal harvest made in this study are comparable to those of other comprehensive violation simulation studies. For example Bessey (1983) estimated that harvest through nightlighting in Manitoba was

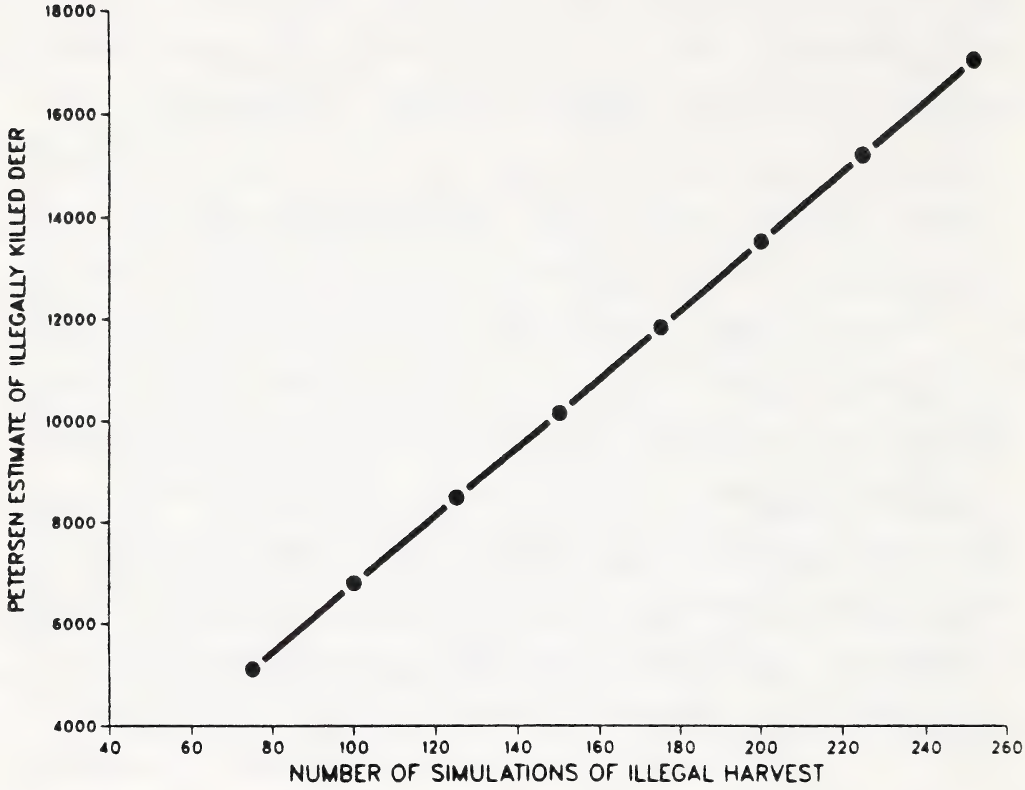


Figure 5. The Effect of Variation in the Number of Simulations used in the Petersen Method on the Illegal Harvest Estimate.

## TABLE 10

## COMPARISON OF ESTIMATES OF LEGAL AND ILLEGAL DEER HARVEST IN ALBERTA DURING 1985

| | Number of Licensed Deer Hunters in 1985[1] | Deer Harvest White-tailed Estimate By Licensed Hunters[2] | Mule Deer Harvest Estimate By Licensed Hunters[2] | Total Legal Deer Harvest[2] | Illegal Harvest Estimate of At Least One Deer | Illegal Harvest As A Percentage Of Legal Harvest Of Deer[3] |
|---|---|---|---|---|---|---|
| Estimate(s) | 94,389 | 20,505 | 17,942 | 38,447 | 17,012 | 44.2% |
| 95% Confidence Limit | | 570 | 422 | -- | 11,586 | -- |
| Confidence Intervals | | -- | -- | -- | 5,426 - 28,598 | 14.1% - 74.4% |

---

[1] Based upon the number of hunters who purchased one or more of the following licences in 1985: General White-tailed Deer, General Mule Deer, Camp Wainwright Deer, Special Mule Deer Licence.

[2] From Technical Report of 1985 Big Game and Game Bird Harvest in Alberta, Unpublished Report, Wildlife Branch, Alberta Fish and Wildlife Division, 1986.

[3] From Figure 4, this study.

10-15% of legal harvest. The estimate in this Alberta study is 7,260 deer (Figure 4) which is about 19% of the legal harvest. Other U.S. estimates are not significantly higher considering larger human and game population densities (e.g. California - Stork and Walgenbach 1973; Michigan - Stoll and Hussain 1979).

It is felt, however, that the results of this study are more reliable than those obtained from other violation simulation studies for the following reasons:

1. A pilot study (Boxall et al. 1984) was conducted to devise a statistically rational sample size, and to provide a template for the conduct of simulations, equal detectability, representativeness of illegal activity and ease of classification.
2. This study represents the most comprehensive study to date, with the greatest number of simulations conducted over the longest time.
3. More reliability in the documentation of recaptures due to the AIR system, which is one of the most detailed occurrence reporting systems in North America (Adams, pers. comm.).
4. More recaptures of simulations (seven) were obtained than in any of the other studies.

## C. Questions and Recommendations for Further Research

The findings of this study and that by Boxall et al. (1984) raise a number of questions about illegal harvest. These are discussed below.

1. What segments of society are poaching deer?

Having identified some measure of illegal harvest provides important information for wildlife managers. It does not, however, answer to whom must illegal harvest be attributed? How much of the harvest is due to organized market hunting groups? How many landowners shoot deer for the dinner table?

Many agencies have tried to answer these questions. For example, Wright (1980) estimated that Iowa farmers poached over 14,000 deer in 1975. He used a randomized response technique in which an interviewer, during the administration of an agricultural survey unrelated to wildlife, asked if they had shot a deer out of season. Wright found that 8.43% of farmers interviewed had poached one or more deer in season. Unfortunately these estimates were not compared to the state's legal harvest estimate and no overall estimate of illegal harvest was determined.

A similar study could be attempted in Alberta. It would be instructive to compare the resulting figures with the illegal harvest measure gathered from this violation simulation study.

2. Why does there appear to be public apathy with regard to poaching?

A problem with the public's attitude or perception of illegal harvest is suggested by the fact that only one out of 20 simulations observed by citizens were reported. However, this problem is complicated by the actual pattern of reports of occurrences to the division. The majority of reports of illegal harvest activities occur during the legal hunting season (Figure 2), despite the fact that a significant amount of illegal market hunting occurs from December to February. It would appear that the public is more aware of hunting activities, both legal and illegal, during the fall and are more likely to report actual violations then.

A number of reasons for the lack of reporting in the closed season seem possible. Three of these are: (i) Violators observed by people are thought to be friends, relatives, or neighbors; (ii) People are not concerned about illegal harvest - either they think it is insignificant or do not care; (iii) People do not know what actually constitutes an offense or violation. These hypotheses are probably not mutually exclusive.

As an example, these three ideas can be used to explain the apparent apathy surrounding public reports of violation by landowners. In general, landowners are the individuals who most frequently report violations to the Fish and Wildlife Division. They have opportunities to observe illegal activity and, in some cases, have something to gain from reporting a violation (e.g. to stop trespassing). However, some landowners may have negative attitudes towards deer because they cause damage to crops or gardens and may not report poaching because it helps to control the number of animals. They may also prefer to have locals taking deer on their land over strangers from other areas.

If this sort of idea is true, then novel management programs involving private land are required to change landowners' perceptions of deer as pests to sources of benefit. If these programs are effective there may be significant increases in landowner reports of illegal activity.

The Fish and Wildlife Division has taken some steps to increase the reporting rate of wildlife law violations through the Outdoor Observer Program. This program involves a 24 hour toll-free phone number to encourage reporting, and a widespread information and educational program about wildlife law violations. At the time this report was written however, no measure of the success of this program was available.

3. What is the biological significance of illegal harvest in Alberta's big game populations?

For the first time this jurisdiction has obtained a measure of the magnitude of the illegal deer harvest. The measure may be approximate, but has been gathered through specific research and should be defended or rejected based upon scientific principles, not through subjective intuition.

However, illegal harvest is only one component of the total mortality facing deer in Alberta. Other components include Treaty Indian harvest, legal licensed harvest, automobile collisions, parasites and disease, predation and winter weather. To assess the significance of illegal harvest, it must be compared to total mortality and related to deer population sizes and fluctuations in numbers. Further steps in the effective management of Alberta's deer populations must include accurate estimation of these mortality factors and detailed population inventory work which can be used to produce a better predictive population model.

# LITERATURE CITED

Adams, R.J. 1986. Animal incident reporting system confidence level study. Enforcement-Field Services Branch Report, Alberta Fish and Wildlife Division. Edmonton, Alberta.

Bailey, N.J.T. 1951. On estimating the size of mobile population from recapture data. Biometrica 38:293-306.

Bessey, K.M. 1983. Analysis of the illegal harvest of White-tailed deer in Agro-Manitoba: Implications for program planning and management. Master of Natural Resource Management Thesis, Natural Resources Institute, University of Manitoba. Winnipeg, Manitoba.

Boxall, P.C., M.J. Melnyk and L. Cormier. 1984. The estimation of illegal activity relating to wildlife in Alberta: a pilot study using violation simulation techniques. Enforcement-Field Services Branch, Special Investigation Report Number 3. Alberta Fish and Wildlife Division. Edmonton, Alberta.

Kaminsky, M.A. and R.H. Giles. 1974. An analysis of deer spotlighting in Virginia. Pp.729-740. In: Proceedings of the Southeastern Assoc. Fish and Game Commissioners 1974 Conference.

Lincoln, F.C. 1930. Calculating waterfowl abundance on the basis of banding returns. U.S. Dept. of Agric. Circ. No. 118, 1-4.

Overton, W.S. 1971. Estimating the numbers of animals in wildlife populations. In R.H. Giles, Jr (ed.), Wildlife Management Techniques, Third Edition. Pp 403-455 . The Wildlife Society, Washington, D.C.

Pursley, D. 1977. Illegal harvest of big game during closed season. New Mexico Department of Game and Fish (Mimeogr.).

Robson, D.S. and H.A. Regier. 1964. Sample size in Petersen mark - recapture experiments. Trans. Amer. Fish. Society 93:215-226.

Seber, G.A.F. 1982. The estimation of animal abundance and related parameters. Second Edition. Charles Griffin and Co. Ltd., High Hycombe, England.

Special Investigation Unit. 1983a. Trafficking in Fish and Wildlife in the Peace River and Bonnyville Areas. Enforcement-Field Services Branch, Special Investigation Report Number 1. Alberta Fish and Wildlife Division. Edmonton, Alberta.

Special Investigations Unit. 1983b. Organized wildlife law violators in the Calgary area. Enforcement-Field Services Branch, Special Investigation Report Number 3. Alberta Fish and Wildlife Division. Edmonton, Alberta.

Stoll, G.D. and N. Hussain. 1979. An estimation of illegal deer losses in Michigan. Project W-121-12. Michigan Department of Natural Resources. Lansing, Michigan.

Stork, D.F. and F. Walgenbach. 1973. An evaluation of public compliance with wildlife regulations and the associated influence of law enforcement. Proc. Western Association Game Fish Commissioners 53:16pp.

Vilkitis, J.R. 1968. Characteristics of big game violators and extent of their activity in Idaho. M.S. Thesis. University of Idaho. Moscow, Idaho.

Vilkitis, J.R. 1971. The violation simulation formula proves as reliable as field research in estimating closed season illegal big game kill in Maine. Trans. Northeast Sect. Wildlife Society 28:141-144.

Wright, V.L. 1980. Use of randomized response technique to estimate deer poaching. Wildlife Society Bulletin 8:342-344.

# APPENDIX I

## The Petersen Method: Detailed Calculations

Violation simulation makes use of a technique originally used by Lincoln (1930) to estimate the total number of ducks in North America. The technique involves marking and releasing a certain number of animals captured at random from the population. At a later time another random sample is live-captured from the population and the proportion of marked animals in this second sample is noted. An estimate of the total population can now be derived by dividing the total number of marked individuals released in the first sample by the proportion of marked individuals captured in the second sample. This estimate is often referred to as the Petersen estimate or Lincoln Index and can be summarized arithmetically in the following formula (Seber 1982).

$$N = \frac{MC}{R}$$

where M = number of marked animals in the first sample, C = number of animals captured in the second sample and R = number of marked animals recaptured in the second sample.

Since the early work of Lincoln and other biologists, attention was devoted to investigating the precision of the Petersen estimate. Bailey (1951) found that by adding 1 to the terms in the numerator and denominator the equation was accurate when 0 recaptures were made:

$$N = \frac{(M+1)\ (C+1)}{(R+1)} - 1 \qquad \ldots .\ 1$$

Bailey (1951:296) also derived the variance of the Petersen population index:

$$vN = \frac{M^2 (C+1)(C-R)}{(R+1)^2 (R+2)} \quad \ldots 2$$

This formula can be used to calculate confidence intervals around the Petersen estimate. In this study the formula representing the 95% confidence interval is:

$$N \pm 95\% \text{ C.L.} = N \pm 1.96 \sqrt{v_N} \quad \ldots 3$$

The Petersen estimate is unbiased when 1 is added to each factor in the equation (eqn 1; Robson and Regier 1964). However, one condition necessary for an unbiased estimate is that the sum of the marked and recaptured samples must equal or exceed the population size:

$$M + C \geq N$$

The downward bias in the estimate when this condition does not hold has been approximated by Robson and Regier (1964) as:

$$100e^{-\frac{(M+1)(C+1)}{N}} \quad \ldots 4$$

This bias is negligible when the product of the two samples exceeds the population size by four times:

$$(M)\ (C) < 4N$$

3 3286 07570130 6